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A BOTANICAL PROBLEM[1]

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"CONSIDER the lilies how they grow." Thus spake the great Master now just nineteen hundred years ago. And this statement from Him is prima facie evidence that the people of this period knew something of plants and of their growth. For it was the habit of this Teacher to base His lessons on the known and familiar. But we have evidence from many other sources that the study and observation of plants was at this time by no means new. When one searches the records for the beginnings of man's interest in and work with plants, one finds the story extending back not only to the earliest days of recorded history but far into those more remote times regarding which the archeologists have as yet found only the most fragmentary evidence, and then on into the mists of the past where conjecture alone can guide us. There is very general belief that the plants of the open plains and of the forests were one, doubtless the most potent one, of the factors influencing primitive man as he started on the long trail upward to civilization and his modern supremacy. We know that Neolithic man grew cereals, raised flax and cultivated plants bearing fruit and nuts. Moreover we find his grains such that they must have been the result of long ages of cultivation and improvement. With those still earlier practices, which must have antedated by many epochs those of Neolithic man, one's imagination may play at will.

Whatever the first abodes of man, whether caves or the sheltering branches of trees, the fact of a more or less fixed habitation, a pausing in his wanderings at some definite point, was undoubtedly a most significant step in that progress which led eventually to man's present estate. We know that two factors

[1] Address of the retiring president of the Botanical Society of America, read at Cleveland, December 31, 1930.

must have been of paramount importance in selecting these stations—the presence of water and land bearing plants suitable for man's need at this time. At first man used only what the land about his temporary abode naturally produced of herbage and fruitful plants. But presently he came to gather seed and to grow those plants which he most desired, thereby reducing or eliminating others for which he had no need. Thus very early in his history man began that ever-continuing process of changing the flora of the lands on which he squatted. When at times he yielded to that roving spirit which was still strong within him, he would move on, and sooner or later he came to take with him seeds of the plants most prized and to plant these seeds about the new habitation in places where each kind of plant would best thrive. This must have been so, else whence came the improved fruits and seeds used by Neolithic man? It thus becomes evident that those prehistoric workers with plants were not only agriculturists, they were also ecologists, a branch of botany so recently organized in its modern form that many of us here present remember when the word ecology was not in the dictionaries. But the fundamental conception of this phase of botany has undoubtedly influenced man's operations since his first feeble reachings out as an economic being. Not only were these primitive peoples agriculturists and ecologists, but we find, very early in the upward climb, indisputable evidence that they were also plant breeders. Neolithic man continued to improve, doubtless unconsciously through selection, the cereals which he inherited from earlier races of men. He seems also to have learned something of anatomy, for in his attempts to satisfy new needs that he came to sense in the early dawn of that higher social life toward which he was groping, we find him cultivating hemp and using the fibers thereof in the weaving of fabrics. It is thus clear that man's first intelligent reactions to the plant kingdom were from the standpoint of what is known as economic botany. Unquestionably his practices were crude and his apprehension slight. But they mark the beginnings of the growth of our knowledge of plants along some of the most important lines of botany extant to-day. To be sure there were, so far as we know, for long ages after man became interested in using and cultivating plants, no organized schools or centers for the dissemination of knowledge. But must we therefore conclude that man's mind during this period was totally untrained? We are too prone to accept the idea that "all learning is confined within our academic halls." There is another and I venture to think a greater school—the school of experience. And it was in this school that man learned his first lessons in botany.

Most historical writers of the subject during the last century place the beginnings of botany with the writings of Aristotle and Theophrastus. We would not discredit their contributions, but if we accept theirs as the beginning what shall we do with such evidences as those already referred to, or with those other records which indicate that the Egyptians were intelligent observers and growers of plants more than 3,000 years before Christ? What of those interesting slabs which depict King Ashur-nasir-pal and his attendants, almost a thousand years before Christ, artificially pollinating the date palm and thus apparently appreciating, and for all that we know understanding, something of the fact of sexuality in plants? And again there are the descriptions of plants written by Hippocrates, an early taxonomist, who was over seventy years old when Aristotle was born. Have not these and other studies and practices with plants, that might be mentioned, as just a claim to recognition by botanists as have Aristotle's more philosophical writings regarding plants? This great scholar passes over the idea of sex in plants with the statement that it is against their nature, thus ignorant of or ignoring the practices of the early Assyrians as illustrated in those bas-reliefs, just referred to, which are now in the British Museum.

The answer to these questions depends naturally on what one means by the term botany. If one consults various dictionaries, encyclopedias, histories of botany and etymological works, one finds two very distinct conceptions as to just what the word connotes. Certain of us would accept Professor A. B. Rendle's definition, as recorded in the Encyclopedia Britannica, that "Botany is the science that includes everything relating to the vegetable kingdom." This is practically in accord with, though less explicit than, the description of the subject to be found in the New Standard Dictionary. Here botany is defined as "the science which treats of plants," and is divided into eleven, apparently coordinate, branches. Among the branches recorded is economic botany, which the writer says "includes agriculture, forestry, horticulture, floriculture, and cognate subjects." Surely one could not hope for any conception more all-inclusive than are these. Others of us, and I suspect the larger group, would accept the view most frequently given and well illustrated by Professor Coulter's description of botany as outlined in the New International Encyclopedia. He places the beginnings of what he calls "scientific" botany with the classification of plants, citing Hippocrates as the first writer or student of "scientific" botany. He states that botany has become a very diversified subject, but, according to the classification which he gives, he would limit the use of the term to those aspects of the subject

which have no immediate application whatsoever to problems of utility. That is, he would make botany strictly a pure science and relegate all phases of the science which are directly concerned with practical problems to other, or what he calls "related" sciences, as agriculture, horticulture, etc. It would appear then that we have among botanists in general, as have the taxonomists, the "lumpers" and the "splitters."

There is fairly good evidence which I shall not attempt to detail here that up to the sixteenth century, botany included, as Rendle says, "everything relating to the vegetable kingdom." At the same time it is evident that the great diversity of approaches to the subject, its many-sidedness, were fully recognized long before the beginning of the Christian era; and that it very early became divided, *not broken up,* into several branches. To this day the branches are increasing in number and the number will continue to increase as modern research extends the boundaries of botanical science. The educational value of those branches which deal with the more practical aspects of the subject were early recognized in formal education. Chrysippos, of the School of Cnidus, wrote a book in the fourth century B. C. on the various kinds of vegetables grown in the garden of the school at Cnidus. And a little later we find Theophrastus basing many of his conclusions on observations made in the botanic garden of the Aristotelian lyceum. He further records his discussions in the classroom regarding the significance of grafting, budding and other horticultural problems. Much later, about 1650, we hear the great educator, Comenius, declaring that there should be gardens in connection with the universities that the sons of noblemen might be trained in the art and science of horticulture. Such was the broad field covered by botany from the earliest time. But about 1600 there began, in certain quarters, a slow but effective process of reduction in the scope of the subject-matter included in the science of botany. In his classical history of botany, Sachs speaks of the botanical writings of Aristotle, Theophrastus, Pliny and Dioscorides. But he places the foundations of modern botany in the sixteenth century with the works of Brunfels, Bock and Fuchs, and in this year (1875) he divides the science of botany into three great departments—morphology and classification, vegetable anatomy, vegetable physiology. Botany, then, at this time is strictly a pure science shorn of all applied phases or branches included in the earlier conceptions of the botanical field. Strictly economic in its beginnings, it is, as discussed by Sachs, no longer in any sense a humanistic subject.

As one contemplates the history of our science from its first inception to the present day, one is forcibly reminded of that remarkable theory of evolution formulated by Empedocles. It will be remembered that in the century before Aristotle he conceived of a method of evolution which consisted first in the establishment on the earth of fairly complex plants. Then there followed a budding off from these plants of parts of organisms, now one part and now another—arms, legs, trunks, ears, eyes, and whatnot, sent off into space. These ejected parts, however, did not remain isolated but tended to come together and to unite. In this reassembling very grosteque animals were built up. Witness the centaurs of Greek mythology. But these misfits were unable to reproduce and hence their kind was not perpetuated. After many trials, animals fit to survive and therefore capable of reproduction were formed. So during the latter days of the Renaissance, or about the close of the sixteenth century, when the science of botany was fairly well established and had sent its branches out in many directions, a budding-off process began. This reached its climax, let us hope, in the latter part of the last century. First one branch and then another became detached until the subject was so depleted or reduced in scope that in the opinion of many to include in the concept of botany, or to refer in the teaching of botany to anything that was grown in the field or that smacked in any way of the nearby and familiar was to debase the pure science of botany.

During the very last years of the last century there were here and there signs that the later stages of the process outlined by Empedocles, that of reassembling the severed parts, was setting in. It began to look as if botanical science was not only to be restored to its primordial scope but, as a result of the unparalleled development of all its parts during the century, it was to take a more significant place among the physical sciences than had heretofore been allotted to it. But, alas, the movement did not project itself into the new century with the vigor that some had anticipated. To-day those who believe in the more comprehensive organizations are more or less quiescent while here and there the budding off continues and it has not stopped with the various phases of applied botany. The tendency at present, however, is not so much a budding off as the result of normal growth, but rather a deliberate self-severing of the buds, perchance those of pure botany—too often it is feared neither to the advantage of the parent stock nor to that of the scion or severed branch.

I well remember the white rage, I know no better phrase to express it, with which one of our most highly esteemed botanists observed in 1900 certain

illustrations in an elementary text-book of botany that had just come from the press. These illustrations were some of the first evidences of a tendency among certain botanists toward reunion. On two pages of the open book there appeared on one a drawing of a properly clothed man's leg, from the knee down, with the trousers well covered with various kinds of hooked and barbed fruits and seeds; and on the opposite page was to be seen a picture of the posterior portion of a cow's body with the tassel of the tail filled with burdocks. "Such a cheapening of our science was not to be tolerated. It was coarse and disgusting." But I submit, what better illustration of the dissemination of fruits and seeds by means of the clothing of animals could Professor Bailey have found? Had he used the picture of a wild lion tearing through the forest with its tail and mane well filled with the fruits of *Harpagophytum procumbens* and a drawing of the orang-outang striding forth with the fruits of *Durio zibethinus* in his hands and various burs of his native haunts clinging to his hairy body, I am positive our distinguished protector of pure botany would have been entirely satisfied, yes, delighted. At about this time another leading botanist of the period was heard discussing with concern the fact that certain practices from the field and garden were creeping stealthily into our college class-rooms. And he warned his hearers that this must be guarded against for eventually it could mean nothing less than a lowering of standards. Such were the extreme "splitters" at the close of the last and the beginning of the present century.

Undoubtedly there are many to-day who feel that such a view-point is justifiable. But were it best at this time, I believe arguments could be presented to show that largely because of this narrower view the science of botany has failed, in a degree, to measure up to the large place which it should hold in modern life and thought. When one compares the field of botany, using the term in its broadest sense, with that of other disciplines, one is inevitably led to the conclusion that the subject-matter of no other department of knowledge is more significant in its relations to human life and progress, is more multisided in its appeal or presents a greater challenge to the intellect or to the imagination. But these values can be fully realized only when there is the greatest possible co-operation between its several branches, and the subject stands in the solidarity of organic union of all its parts. The whole realm of the plant kingdom is intrinsically one. No part can be segregated without mutual loss to all. The problem that confronts botany in the twentieth century is inherent in the very nature of the subject itself. It is inevitable that so diversified a field should have a tendency to break up into smaller units. As a result of this very natural tendency, botany is to-day so split up into parts, each trying to stand alone, that she falls somewhat below the high place that is rightfully hers among the scientific stars of the first magnitude. You recall the story of the day laborers who were asked what they were doing. One replied, "I am cutting stone," another, "I am carving wood." Both facts were perfectly obvious to the questioner. But a third, the man of vision, answered with pride, "I am building a cathedral." Even so, when cordial and vital unity has been established among all members of the botanical body, may the student of plants say in lofty and justifiable pride, "I am a botanist. I am helping to make the world better."

That the lines of cleavage that have been set up are largely artificial is constantly becoming more and more apparent. I listened one day at the *Horticultural* Congress in London last August to two very interesting papers. These papers lost something of their interest for me when I heard them again, given so far as one could judge in the hearing, verbatim, the following week before the *Botanical* Congress meeting in Cambridge. A survey of the programs of the two congresses suggests that these were doubtless not the only instances of repetition. Why then two congresses? Applied and pure botany—can we separate the two? It is a commonplace that the discoveries in pure science to-day become the practices of the shop and of the field to-morrow. But is their value thereby lessened? There seems still to linger with us that "ancient fear of humanizing knowledge." But is not one of the glories of botany the fact that it is constantly making the world a better place to live in? The time is ripe, yes, overripe, when we scientists should abandon, wholeheartedly, the academic tradition that "polite learning and true culture admit no contact with utility."[2] But this is not all, there is another and even more pernicious tendency which is increasingly evident among us. It has nothing to do with utility or applied science. It strikes deep into the roots of the botanical tree. I refer to the breaking-up of pure botany itself into independent non-affiliated groups. Such a process must eventually spell disintegration all along the line.

May I reiterate, we in botanical science shall find our greatest power in the largest unity—a union in organization and in spirit. Let us be parasitologists, pomologists, mycologists, algologists, dendrologists, thremmatologists or any other sort of a botanical ologist, but let us first be *botanists*. The hand can

[2] C. M. Woodward, SCIENCE, December 28, 1906.

not do the work of the eye nor the eye of the foot. Neither can these several organs perform each its own function except as properly joined to the body by means of which they are correctly assembled and their activities coordinated. In like manner should the various branches of botany be united in one great central body—this body big enough, and strong enough, and flexible enough not only to include every phase of botany but to give freedom and inspiration to every one of its numerous ramifications. Such an organization I believe we already have in the Botanical Society of America. If not let it be so changed that it may be fit for the larger responsibility. Or if best discard it, which let us hope will not be necessary, and build up a new organization under whose banner all may enlist. Every student of plants should then be first a member of the great all-inclusive parent organization and secondly a member of the section or branch wherein his own particular field of endeavor lies. Thus united we shall stand in the power and dignity that so great a science deserves; but separated, we shall ever fail to measure up to the high destiny that may be ours. I repeat Professor Arthur's statement made in an address given before this society just ten years ago. "The botanists' realm is the vegetable kingdom."

Is not this then our theme this evening? The scope of botany, unrivalled by that of any other science, and botanical unity. Only, we believe, by the force of such a unity as has been suggested shall botany fulfil, in largest measure, its high mission in the commercial, the intellectual and the cultural life of the world. It is to this larger fraternity that I would call every student of plant life.

HERBERT HOOVER AND SCIENCE

By Dr. VERNON KELLOGG

PERMANENT SECRETARY, NATIONAL RESEARCH COUNCIL

As a boy preparing for college Herbert Hoover decided to go to a university which paid especial attention to science. He went to Stanford University, took major courses there in geology and mining, graduated in 1895, and began at once a successful career as mining engineer. This lasted up to the beginning of the World War, when he gave it up and became known to all the world as relief worker, Food Administrator, Secretary of Commerce, and President of the United States. In all these capacities he has shown a notable appreciation of science and the scientific method, and he has helped materially to support and extend scientific knowledge.

As mining engineer in charge of very large enterprises in Australia, China, Burma, the Ural Mountains, Mongolian Siberia, South Africa and elsewhere he attacked with success various scientific mining and metallurgical problems. Most notable, perhaps, was his success in Australia in advancing the flotation process and in working out means of profitably recovering the zinc content from low-grade silver ores.

In the prosecution of his large mining operations he successfully met important social problems arising from the gathering together of communities of thousands of workmen and their families in parts of the world distant from civilized regions. His great Kyshtim project in the Ural Mountains, for example, maintained a community of 70,000 people who were lifted by him through his scientific and social work from poverty and squalor to a high state of comfort and prosperity.

He is the author (with specialist collaborators) of "Economics of Mining," published by the *Engineering and Mining Journal,* New York City, 1905; also of "Principles of Mining," 199 pp., 1909, McGraw-Hill Book Company, used in mining schools; also of "De Re Metallica," by G. Agricola, founder of the modern science of mineralogy, translated by Mr. Hoover and his wife from the first medieval Latin edition of 1556. To the original text the translators added an important biographical introduction and an invaluable host of annotations and appendices about the development of mining law and mining and metallurgical methods from the earliest times to the sixteenth century. He also is the author of numerous addresses and papers published in mining and engineering magazines and elsewhere. He has lectured on engineering at Stanford and Columbia Universities, and has been president (1920–1921) of the American Institute of Mining and Metallurgical Engineers; president (1920–1921) of the American Engineering Council (federated American engineering societies); chairman of the Advisory Committee of the Food Research Institute, Stanford University (1921–); president (1927) of the International Radiotelegraph Conference; trustee (1920–) of the Carnegie Institution of Washington; trustee (1912–) of Stanford University, and officer or member of various other major national engineering and scientific societies and organizations.

He has been given honorary academic degrees by twenty-five universities, and has been awarded the following medals for scientific merit:

1914—Mining and Metallurgical Society of America—gold; jointly with Lou Henry Hoover for "distinguished contribution to literature of mining." ("De Re Metallica.")

1920—National Academy of Sciences—for "eminence in the application of science to the public welfare."

1928—American Institute of Mining and Metallurgical Engineers—for "achievement in mining."

1929—John Fritz Gold Medal—awarded jointly by the American Society of Civil Engineers, the American Institute of Mining and Metallurgical Engineers, the American Society of Mechanical Engineers and the American Institute of Electrical Engineers for notable scientific or industrial achievement.

In 1902 he was elected member of the American Association for the Advancement of Science, and fellow in 1915. On the occasion of the meeting of the association in Philadelphia in December, 1926, Mr. Hoover made a notable and largely attended public address ("The Nation and Science") in which he emphasized energetically the importance to the nation of science, and urged strongly the support by the people of this country of "pure" or fundamental science as a necessary basis for continuing advance in applied science.

> No greater challenge has been given to the American people since the great war than that of our scientific men in the demand for greater facilities. It is an opportunity to again demonstrate in our government, our business, and among our private citizens the recognition of a responsibility to our people and the nation greater than that involved in the production of goods or trading in the market.

He delivered a similar address ("The Vital Need for Greater Financial Support to Pure Science and Research") before the American Society of Mechanical Engineers in December, 1925. In this address he made the following statement:

> The far-sighted leaders of industry fully recognize the dependence of their progress upon advances in science, and emphasize their belief that fundamental research should be much more greatly aided. . . . We have prided ourselves on our practicality as a nation. Would it not be a practical thing to do to give adequate organized financial support to pure science? If, by chance, we develop a little contribution to abstract learning and knowledge, our nation will be immensely greater for it.

In 1922 he was elected member of the National Academy of Sciences, and in November, 1925, accepted the active chairmanship of a special board of eminent scientific men and outstanding men of public affairs set up by the National Academy to attempt to establish a National Research Fund of several million dollars for the support of work in fundamental science. Mr. Hoover took an active personal part in the work of obtaining pledges for this purpose from large industrial organizations and wealthy men of this country. The amount already pledged is at least five million dollars, with contingent possibility of another five.

As Secretary of Commerce and President he has made an impressive record in bringing about ever increasing support and extension of the work of the government's scientific divisions and bureaus. He became Secretary of Commerce in March, 1921. In the past ten years the appropriations for the support of the (primarily) scientific bureaus of the department have increased as follows: Bureau of Standards, from $1,354,632 to $3,485,671; Bureau of Fisheries, $1,291,810 to $2,640,560; Bureau of Mines, $1,302,642 to $2,729,480; Coast and Geodetic Survey, $2,316,317 to $3,020,104.

It was as a result of his vigorous championship that the establishment of a great National Hydraulic Laboratory ($350,000) at the Bureau of Standards was brought about.

He has been active in having formulated, adopted and enforced various important fish conservation measures based on careful studies by leading scientific fisheries experts of the country. In this connection have been established, under his active sponsorship, an Upper Mississippi River wild life and fish refuge; a Northern Pacific Halibut Convention with Canada, and a generous five-year construction and maintenance program for the Bureau of Fisheries, with special support for its strictly scientific work. He also obtained, after an active struggle, authority for the Secretary of Commerce to say when, where and how salmon and other fishes were to be taken in the waters of Alaska. In exercising this authority, Mr. Hoover placed great dependence on the advice of the late Dr. C. H. Gilbert, one of the country's greatest fishery scientists, as well as his assistant in charge of salmon research, Dr. W. H. Rich.

The Bureau of Mines, transferred in 1925 from the Department of the Interior to the Department of Commerce, was enabled, with the active sponsorship of the Secretary of Commerce, to expand materially its scientific investigations of fundamental problems in the extraction of shale oil and in the extraction of potash from ores occurring in the various parts of the United States.

Mr. Hoover's special interest in aeronautics led to large expansion of the scientific work of the aeronautics branch of the Department of Commerce. The total appropriation for the work of this branch in the year 1927 was $500,000, while in the year 1929 it was over $5,000,000. With this large increase in

funds available, the division was able to develop a comprehensive and far-reaching constructive research program.

While Mr. Hoover was Secretary of Commerce, radio broadcasting was begun. He took great interest in the scientific development of radio and realized the future possibilities of broadcasting. He presided over four national radio conferences and took a lively interest in the proceedings of the International Radio-Telegraph Conference held in Washington in 1927. In 1925 Mr. Hoover negotiated the transfer of the seismological investigations from the Weather Bureau of the Department of Agriculture to the Coast and Geodetic Survey in the Department of Commerce. A direct attack is being made by the survey on the problem of obtaining complete information about all earthquakes occurring in the United States or regions under its jurisdiction, and special investigations are being conducted to discover fundamental facts which may be made available to engineers and builders in connection with building for earthquake resistance. The Coast and Geodetic Survey undertook a survey of the Mississippi River area from Cairo to New Orleans, thus making available basic data touching fundamental problems of flood control.

Mr. Hoover has shown his special interest in promoting scientific care of child health and protection by his organization in 1922 of the American Child Health Association, of which he was the first president, and by the organization of the White House Conference on Child Health and Protection.

But a catalogue of the scientific undertakings encouraged and materially supported by Secretary and, later, President Hoover would be a long one—much too long a one to print here.

As Secretary of Commerce and President, Mr. Hoover's relation to scientific work has been that of encourager, supporter and administrator, necessarily not that of laboratory or field man. As such supporter and administrator of science he has made much and great scientific work possible; and for this he should have the gratitude of scientific men.

What President Hoover said of Dr. W. H. Welch in his impressive address at the celebration, in April, 1930, of Dr. Welch's eightieth birthday may well be said of Mr. Hoover:

> Our age is marked by two tendencies, the democratic and the scientific. In Dr. Welch and his work we find an expression of the best in both tendencies. He not only represents the spirit of pure science but constantly sees and seizes the opportunities to direct its results into the service of humankind.

OBITUARY

MEMORIALS

The centenary of the birth of James Clerk Maxwell is to be celebrated in the University of Cambridge on October 1 and 2, following on the Faraday celebration and the centenary meeting of the British Association in London. Addresses are to be given at Cambridge by Professors Einstein, Langevin, Larmor, Planck, Sir James Jeans and Sir J. J. Thomson.

As its contribution to the celebration of the hundredth anniversary of the discovery of electromagnetic induction by Michael Faraday in England and Joseph Henry in America, two lectures have been given at the Massachusetts Institute of Technology. Faraday was the subject of the first lecture, which was given on February 13 by Dr. W. F. G. Swann, director of the Bartol Research Foundation of the Franklin Institute, and Dr. W. F. Magie, Henry professor of physics, emeritus, of Princeton, lectured on February 18 on the life of Joseph Henry. Both lectures were open to the public.

The Hunterian Society of London commemorated the two hundred and third anniversary of the birth of John Hunter by a banquet at the May Fair Hotel on February 19.

At a recent meeting of the Board of Health of New York City the following resolutions were adopted:

> Whereas, Dr. Charles Krumwiede, an assistant director in the Bureau of Laboratories, has passed to the great beyond at the early age of fifty-one years, and
>
> Whereas, Since his connection with the laboratory in 1909, Dr. Krumwiede was an invaluable, resourceful and most painstaking worker, and
>
> Whereas, His studies on the types of tubercle bacilli, on bacilli of the typhoid-colon group, on psittacosis and on many other important bacteriological problems added lustre to the work of the Bureau of Laboratories, be it therefore
>
> *Resolved*, That the Board of Health record on its minutes its very great appreciation of the work of this distinguished scientist and its great sorrow at the passing of so talented an investigator and able administrator, and be it further
>
> *Resolved*, That a copy of these resolutions be sent to the bereaved family with an expression of the board's deep sympathy in its irreparable loss.

RECENT DEATHS

Dr. Veranus A. Moore, from 1908 to 1929 director of the New York State Veterinary College at Cornell University, died on February 11, at the age of seventy-two years.

Handel T. Martin, assistant curator of the University of Kansas Museum of Paleontology, died in Lawrence on January 15. He was sixty-eight years old.

John H. Liggett, assistant professor of psychol-

ogy in the University of California at Los Angeles, died on February 10 following an operation.

SIR ANDREW BALFOUR, director of the London School of Tropical Medicine, died on January 29, at the age of fifty-seven years.

PROFESSOR ARCHIBALD LEITCH, director of the research department of the Cancer Hospital, Fulham, London, died on January 2, at the age of fifty-two years.

DR. M. W. BEIJERINCK, the Dutch bacteriologist, known for his many valuable contributions to microbiology, died at his country home at Gorssel, Holland, on January 1, at the age of seventy-nine years.

PROFESSOR GEORGE WEISS, formerly dean of the Faculty of Medicine at Strasbourg, died on January 24. A correspondent states that "Professor Weiss was an important figure in the decade following the armistice, since he was entrusted with the deanship and the organization of the French Medical Faculty at Strasbourg."

FEDERIGO GUARDUCCI, until his retirement professor of theoretical geodesy in the University of Bologna, died on February 7, at the age of eighty years.

DR. C. Y. WANG, professor of pathology in the University of Hongkong, died on December 16 after an illness of some months at the age of forty-two years. Dr. Wang was a fellow of the Royal College of Physicians of Edinburgh.

SCIENTIFIC EVENTS

MUSEUM SPECIMENS

AN exhibition has been held in London of museum specimens specially prepared for rural areas. According to the account in the London *Times*, the display was arranged by the Museums Association (aided by a grant from the Carnegie United Kingdom Trust) to synchronize with the annual meeting of the Association of Directors and Secretaries for Education. Sample exhibits arranged for circulation to schools were lent by various American institutions, as well as by a number of museums in England.

The Liverpool collection, of which a nucleus began to be formed for circulation to 64 schools in 1884, is an example of pioneer work. During the years in which the exhibits have grown their sphere has also been extended, so that some 136 schools (not all within the city boundaries) are now drawing on the collection. Some of the cases have seen hard service, and the newer models among the cases are lighter and better arranged; thus pictures and tools representing the men of the Early Stone Age appear manageably together, and the plumage of birds is sent round in a light tube for special study.

A different method is used by the Bagshaw Museum and Art Gallery, administered by the Batley Corporation; this institution uses light folding boxes, each containing 20 specimens, to illustrate some single branch of knowledge. Each specimen is in a small transparent circular container, designed to be handed round to the children of the class with an appropriate label. This scheme has been applied during the past nine years to the service of 17 elementary schools, and has extended the range of subjects rapidly on a grant of only £20 a year.

The portable exhibits of the Tolson Memorial Museum have been designed to provide knowledge of general subjects through local examples, which are very varied, in the field of geology and the natural sciences, as well as in past rural industries and ancient monuments. Special maps have been made for circulation by the museum to illustrate the local geographical distribution of natural and historical features, and a scheme is coming into operation whereby the main branches of study can be radiated outside the county borough through eight rural centers to a more numerous range of villages.

A still more ambitious scheme of circulation is that provided within the past 12 months by the Leicester Museum and Art Gallery, which adds to its series of small traveling cases of antiquities and local natural history a series of framed water-colors, prints and drawings, which are equally available for circulation to rural communities, not necessarily schools.

Most of the other museums represented in the exhibition follow one of the general plans mentioned above. But the large-scale dissections of botanical and zoological specimens sent out for the past 15 years by the Dorman Memorial Museum, Middlesbrough, and the essay scheme on local natural history with which the Perthshire Museums accompany a circulation scheme, now 30 years old, are said to deserve commendation. The City of Salford shows some large tableau cases, and the Reading Public Museum has a display illustrating through some 46 specimens (all of which go into a small dispatch case) the natural, industrial and scenic resources of Canada.

The American contributions largely duplicated some of the British displays, but the automatic motion-picture projectors from the American Museum of Natural History and the miniature human figures

lent by the Buffalo Museum of Science are noted as of great interest.

FIELD MUSEUM OF NATURAL HISTORY

MORE than two million persons received direct educational benefits from the Field Museum of Natural History during 1930. Of this number, 1,332,799 were visitors to the museum, while more than 716,000 were school children who participated in the extra-mural activities conducted by two special units of the museum organization—the N. W. Harris Public School Extension which circulates traveling natural history and economic exhibits to schools and community centers, and the James Nelson and Anna Louise Raymond Foundation, which provides lecturers, motion pictures and other means of supplementary education.

The 1,332,799 persons visiting the museum itself represented an increase of 164,369 or more than 14 per cent. over the previous year. Of these, approximately one third were children, according to Mr. Stephen C. Simms, director of the museum. It is of interest to note that of the total number of visitors, only 160,924 paid the 25-cent admission charged to adults on Mondays, Tuesdays, Wednesdays and Fridays; while 1,171,875 persons were admitted free of charge, this including those attending on Thursdays, Saturdays and Sundays, the free days, and all the children who are admitted free every day.

The activities of the Harris Extension reached more than 500,000 children in 430 schools and other gathering places. Those of the Raymond Foundation, including both programs presented in the museum and those presented in the schools, reached 277,245 children. For adults, twenty-seven illustrated lectures on science and travel were presented, and in addition, various series of guide-lecture tours, which attracted a total attendance of 37,031.

The election by the board of trustees of Field Museum of two new honorary members of the museum, and one patron, are announced by Stephen C. Simms, director. Mr. Arthur S. Vernay, of New York and London, and Mrs. E. Marshall Field, of New York, are the honorary members, elected in recognition of their eminent services to science. Mr. Philip M. Chancellor, formerly of Chicago and now a resident of Santa Barbara, California, is the patron, elected in recognition of eminent services to the museum. Mr. Vernay financed and led the Vernay-Lang Kalahari Expedition for Field Museum last year. This expedition brought the museum a vast zoological collection of African mammals, birds, fishes and invertebrates, numbering several thousand specimens, and also important botanical and ethnological collections.

Mrs. E. Marshall Field has long manifested a deep interest in science, and has actively participated in scientific work in the interest of the museum. Several years ago she was a member of a Field Museum expedition which made large collections of botanical, geological and zoological material over a wide range of South American territory. Mr. Chancellor has financed and led two museum expeditions, the Chancellor-Stuart Expedition to the South Pacific (1929–30), and the Chancellor-Stuart Expedition to Aitutaki, Cook Islands (1930). Both of these brought the museum valuable zoological collections.

LATIN AMERICAN FELLOWS OF THE GUGGENHEIM FOUNDATION

THE trustees of the John Simon Guggenheim Memorial Foundation announce the appointment of seven fellows from Argentina and Chile who will come to the United States in the course of the next few months to carry on advanced work and research in various fields of knowledge. These fellows are the first to be appointed from Argentina and Chile as Latin American fellows of the foundation.

Established in 1925, the foundation, for a time, made its grants for work abroad only to citizens or permanent residents of the United States, but two years ago former U. S. Senator and Mrs. Simon Guggenheim, the founders of the fellowships in memory of a son who died in 1922, added a one-million dollar endowment to set up a plan of Latin American Exchange Fellowships to be additional to the work of the foundation in the United States, already endowed with their gift of $3,500,000. Mexico was first included in the new plan and, with this announcement, its benefits are extended to Argentina and Chile.

The foundation had announced that this year two fellowships in each country would be granted in Argentina and Chile. Induced however by the large number and high quality of the applicants in each, four were granted in Chile and three in Argentina.

The Latin American fellowships of the foundation are planned as an exchange of scholars between the countries of the two Americas, and Senator Guggenheim has said: "We are proceeding in the conviction that we have much to learn in those countries that are our elder sisters in the civilization of America and much to give their scholars and creative workers. That is fundamental to our thinking on this subject."

In accordance with these plans scholars from the United States who plan to work in Latin America will be selected in this country in March, and at that time fellows from Mexico and Cuba will also be chosen. The Latin American fellows of the foundation just appointed are the following:

From Chile:—Eduardo Bunster Montero, School of Medicine, University of Chile, will carry on studies in the physiology of certain glands of internal secretion at Harvard University. Manuel Elgueta Guerin, Genetics

Division of the Experimental Station of the National Agricultural Society of Chile, will study the application of genetics to the improvement of plants at Cornell University. Joaquin Monge Mira, professor of geology in the Catholic University of Chile, will work on problems of harbor improvement and flood control. Genaro Moreno Garcia-Conde, professor of mathematics in the School of Military Engineering of Chile, will undertake mathematical research, especially in the theory of functions of real variables.

From Argentina:—Salomon Horowitz, chief of the Institute of Genetics of the University of Buenos Aires, intends to carry on studies in cytology and genetics. Homero Mario Gugliemini, a writer of Buenos Aires, will study the principal currents of philosophy in the United States. Carlos Garcia Mata, of the Department of Finance and Public Works in the Province of Santa Fé, Argentina, will study, at the Harvard Graduate School of Business Administration, methods of predicting economic phenomena.

These Latin American fellowships of the foundation are granted on terms generally similar to those governing the John Simon Guggenheim Memorial Fellowships in the United States. They are open to men and women, married or unmarried, without distinction of race, color or creed. Fellows from the United States to Latin America, or from Latin America to the United States, are not restricted in choice of university or other place of study.

The stipend for these fellowships, either for Latin America or for the United States, is $2,500 a year plus a travel allowance. The fellowships are awarded in the first instance for one year, but with the possibility of renewal.

NATIONAL RESEARCH FELLOWSHIPS IN THE BIOLOGICAL SCIENCES

The Board of National Research Fellowships in the Biological Sciences, which includes within its scope the fields of anthropology, psychology, botany, zoology, agriculture and forestry, held its first meeting in 1931 on January 31 and February 1, and made twelve reappointments and seventeen new appointments for the academic year 1931–32, as follows:

Reappointments

For domestic study:

O. D. Anderson—psychology
L. W. Gellermann—psychology
E. Harold Hinman—zoology
Ancel B. Keys—zoology
R. K. Meyer—zoology
Elsa R. Orent—biochemistry
Daniel Raffel—zoology
Hugh M. Raup—botany
Gene Weltfish—anthropology
Samuel Yochelson—psychology

For study abroad:

George Kreezer—psychology
T. L. Steiger—agriculture

New Appointments

For domestic study:

G. W. Adriance—agriculture
S. H. Bartley—psychology
Lyman C. Craig—agriculture
S. T. Dexter—agriculture
Clarence H. Graham—psychology
S. R. H. Hall—zoology
E. W. Hopkins—agriculture
Burt P. Johnson—botany
Samuel L. Leonard—zoology
Marion L. Lohman—botany
B. F. Skinner—psychology
Frederick K. Sparrow, Jr.—botany
Raymond G. Stone—zoology
F. P. Zscheile, Jr.—botany

For study abroad:

H. H. Jasper—psychology
Victor C. Twitty—zoology
Wm. Caldwell Young—zoology

The second meeting for further appointments for 1931–32 is planned for about April 30 and May 1, and applications for consideration at this meeting should be filed not later than March 15. Information and application forms may be obtained from the Secretary, Board of National Research Fellowships in the Biological Sciences, National Research Council, Washington, D. C.

Frank R. Lillie, *Chairman*
Board of National Research Fellowships in the Biological Sciences

THE INDIANAPOLIS MEETING OF THE AMERICAN CHEMICAL SOCIETY

The eighty-first meeting of the American Chemical Society will be held in Indianapolis from March 30 to April 3. New knowledge of life processes in both health and disease through the systematic use of chemistry will be a chief field of discussion. More than 1,500 men and women of science are expected to attend.

The opening event, according to the preliminary program, made public by Secretary Charles L. Parsons, will be a meeting of the council at 2 P. M. on Monday, March 30, the president of the society, Professor Moses Gomberg, of the University of Michigan, presiding.

Three symposiums will be given on March 31. One, on "Contemporary Developments in the Chemistry of Physiologically Active Substances," under the auspices of the Divisions of Biological, Medicinal and

Organic Chemistry, with Professor James B. Conant, of Harvard University, as chairman.

A second symposium, on "Cooperation between Industry and Chemical Education," will be sponsored by the Division of Chemical Education, of which Dr. John N. Swan, of Tuckahoe, New York, formerly head of the department of chemistry in the University of Mississippi, is chairman. Teachers from high schools and colleges all over the United States will participate. Exhibits from high-school chemistry classes in many states will compete for prizes. There will also be an exhibition of chemical apparatus and products by manufacturers. On April 1 the Senate of Chemical Education, composed of representatives of education and industry, will convene to receive reports of committees. On April 2 the members of the division will attend the dedication at Bloomington of the new chemistry building of the University of Indiana.

A third symposium, on "Mathematics in the Service of Chemistry," will be given by the Division of Physical and Inorganic Chemistry, of which Professor Farrington Daniels, of the University of Wisconsin, is chairman.

"Dietary Facts and Fads" will be the subject of a public address at 8:30 P. M. on April 1 by Professor William C. Rose, of the University of Illinois. The Divisions of Gas and Fuel Chemistry, Industrial and Engineering Chemistry, and Petroleum Chemistry will combine in joint sessions on the "Utilization of Gaseous Hydrocarbons." New and unpublished research work at agricultural experiment stations will be reported at a meeting of the Division of Agricultural and Food Chemistry, headed by Professor James S. McHargue, chief chemist of the Kentucky Agricultural Experiment Station at Lexington.

The Division of Cellulose Chemistry, Frederich Olsen, director of research of the Western Cartridge Company, East Alton, Illinois, chairman, and the Division of Colloid Chemistry, Professor R. A. Gortner, of the University of Minnesota, chairman, will join in a symposium on "The Physical and Colloid Chemistry of Cellulose and Cellulose Derivatives."

The Paint and Varnish Division, of which P. R. Croll, of Milwaukee, is chairman, will discuss plans for nation-wide research to improve the finish and durability of protective coatings.

Sanitation, water softening, sulfide wastes and other problems of the water supply of cities will be discussed before the Division of Water, Sewage and Sanitation Chemistry. The Division of Sugar Chemistry, the History of Chemistry Division and the Division of Rubber Chemistry will also meet.

Divisional officers of the society will convene on the morning of April 1, Erle M. Billings, of the Eastman Kodak Company, presiding. Officers of the eighty local sections will gather on the morning of April 2, with Dr. H. T. Herrick, of the Bureau of Chemistry and Soils, Washington, D. C., as chairman.

Trips of inspection to the industries and educational institutions of Indiana and many social events, including group dinners and luncheons, have been arranged. J. K. Lilly, R. E. Lyons and P. C. Reilly, of Indianapolis, have been named honorary chairmen of the general convention committee. Harry E. Jordan is general chairman.

The business reorganization of the society, reports of officers and committees, endowment plans and expansion of publications, involving the world-wide reporting of scientific developments for the use of American men of science, will be taken up by the council.

SCIENTIFIC NOTES AND NEWS

Dr. David Starr Jordan, chancellor emeritus of Stanford University, celebrated his eightieth birthday on January 19. Dr. Jordan was able to sit up for a short time to receive his most intimate friends. As a permanent expression of appreciation faculty, alumni and friends presented the "Jordan Room," his former office in the Zoology Building. This is to provide "a room beautiful in form and color, comfortable and convenient, in which his favorite subjects can be pursued for years to come." In Danville, at the foot of Mount Diablo, students planted a valley oak as a suitable expression of the strength manifested in Dr. Jordan's life. Dr. Barton W. Evermann, one of Dr. Jordan's first students at Indiana, was the principal speaker.

Dr. William H. Welch, professor of the history of medicine, and Dr. William H. Howell, professor of physiology and director of the School of Hygiene and Public Health of the Johns Hopkins University, will retire at the end of the present academic year. Dr. Welch was the first professor of pathology at the Johns Hopkins University School of Medicine, having been appointed in 1884. In 1916 he became the first director of the School of Hygiene and Public Health. In 1926 a chair of the history of medicine was created for him and in 1929 the new medical library was dedicated in his honor. Dr. Welch's eightieth birthday on April 8 of last year was marked by an international celebration. Dr. Howell, whose seventy-first birthday occurred on February 20, has been professor of physiology since 1893, succeeding Dr. Welch as director of the School of Hygiene and Pub-

lic Health in 1926. He was president of the International Physiological Congress held at Harvard University in 1929.

DR. ALBERT EINSTEIN will leave Pasadena late in February on his way home to Berlin. He expects to sail from New York on March 4. Just before sailing Professor Einstein will be the guest of honor at a dinner at the Hotel Astor to start a campaign for $1,000,000, the New York City quota in the nation-wide American-Palestine campaign for $2,500,000. More than 1,000 guests, who will pay $100 each, are expected to be present.

THE degree of doctor of science has been conferred by the University of Pittsburgh on Dr. Harlow Shapley, professor of astronomy and director of the Harvard College Observatory; Dr. Edward Ellery, professor of chemistry and dean of the faculty of Union College and secretary of Sigma Xi; Dr. George E. Coghill, of the Wistar Institute of Anatomy and Biology, and Dr. George W. Stewart, head of the department of physics at the University of Iowa.

RECIPIENTS of honors bestowed on the occasion of a dinner on February 18 of the American Institute of Mining and Metallurgical Engineers include Francis W. MacLennan, of Miami, Arizona, who receives the William Lawrence Saunders Medal for discovering a method to produce copper profitably from ores which had been considered virtually worthless; William H. Peirce, of Baltimore, the James Douglas Medal for numerous improvements in devices for smelting, refining and rolling copper; Edmund S. Davenport, of Kearny, New Jersey, the Robert W. Hunt award, for studies in cast iron, tungsten, thorium and transformation of austenite. Professor Waldemar Lindgren, geologist of the Massachusetts Institute of Technology, was made an honorary member of the institute.

DR. ALEXANDER WETMORE, assistant secretary of the Smithsonian Institution, has been elected an honorary member of the Ornithological Society of Bavaria.

SIR WILLIAM BRAGG, Fullerian professor of chemistry in the Royal Institution, has been elected an honorary member of the British Institution of Electrical Engineers.

THE gold medal of epidemics has been conferred posthumously on the late Dr. Ernest Conseil, director of the Health Office of Tunis, and collaborator with Dr. Charles Nicolle in his work on typhus, cholera and plague.

THE Buchan Prize of the Royal Meteorological Society, awarded biennially for the most important original papers contributed to the society during the previous five years, was presented to Dr. C. E. P. Brooks at its meeting on January 21.

OFFICERS of the American Society of Naturalists were elected at the Christmas meetings as follows: Dr. S. J. Holmes, University of California, *president;* Dr. E. J. Kraus, University of Chicago, *vice-president;* Dr. Sewall Wright, University of Chicago, *treasurer;* Dr. Leon J. Cole, University of Wisconsin, *secretary.*

DR. MORRIS M. LEIGHTON, state geologist of Illinois, was elected president of the Association of American State Geologists and Dr. George C. Brannon, of Arkansas, secretary, at the recent annual meeting held in Washington, D. C. Plans were discussed for the sixteenth International Geological Congress, to be held in Washington in June of next year. Dr. W. C. Mendenhall, acting director of the Geological Survey, sketched the history of the congress. The major topic for investigation, he said, would be the petroleum resources of the world. A special committee has been appointed to deal with this topic. Its findings will be compiled and published in a monograph for distribution at the congress. A considerable sum is necessary in order to make the meeting a success. The Geological Survey is seeking a special grant from the federal government to aid in defraying expenses.

PROFESSOR GEORGE H. MEAD, head of the department of philosophy at the University of Chicago where he was appointed assistant professor in 1894 and has been professor since 1903, resigned on February 5, owing, it is said, to differences of opinion concerning an appointment made in the department by President Robert M. Hutchins. Dr. Mead will lecture at Columbia University next year. Professor Edwin A. Burtt and Associate Professor Arthur Murphy have also resigned, having accepted positions at Cornell University and Brown University, respectively.

MR. HAROLD L. MADISON has been appointed director of the Cleveland Museum of Natural History. For thirteen years Mr. Madison was director of the Park Museum, Providence, Rhode Island. In June, 1921, he became curator of education at the Cleveland Museum, and was appointed acting director upon the resignation of Paul M. Rea in January, 1928. From 1918 to 1922 Mr. Madison was secretary of the American Association of Museums.

DR. EDWARD R. WEIDLEIN, director of the Mellon Institute of Industrial Research at Pittsburgh, has announced the appointment of Dr. Leonard Harrison Cretcher to an assistant directorship in the institution. Dr. Cretcher, who since 1926 has been serving

as head of the department of research in pure chemistry, is a specialist in organic chemistry and will have supervisory charge of a group of industrial fellowships that are concerned with problems in organo-chemical technology. In addition to serving in this capacity, Dr. Cretcher will continue as head of the department of research in pure chemistry. In this work he will be aided by Dr. William L. Nelson, who has been made senior fellow in pure research. Beside Drs. Cretcher and Nelson, the departmental staff will include Dr. C. L. Butler and Dr. Alice G. Renfrew, who has gone to the Mellon Institute from the Sterling Chemistry Laboratory of Yale University.

DR. J. VOLNEY LEWIS, of New York City, has resigned as staff geologist for foreign operations of the Gulf Oil Corporation and has joined the staff of "A Century of Progress," where he will undertake to organize the work in geology, mining and metallurgy for the Chicago International Exposition in 1933 and to assemble the appropriate exhibits. The plans are being made and the work will be carried out with the cooperation of the National Research Council.

DR. C. E. K. MEES, director of research and development at the Eastman Kodak Company, who for a number of years has been an assistant editor of *Chemical Abstracts* in charge of the photographic section, has resigned, and Dr. E. P. Wightman, research chemist at the Eastman Kodak Company, has been appointed his successor.

DR. FLOYD W. VON OHLEN, formerly of the Ohio State University, has been appointed instructor in botany in the department of biology at Long Island University, Brooklyn, New York.

SEVEN dismissals from the faculty of Transylvania College at Lexington, Kentucky, are reported. They include Dr. C. A. Maney, for eleven years head of the department of mathematics. Dr. Maney is said to have received a letter stating that for purposes of economy his services would not be required next year. Transylvania College is supported by the "Disciples of Christ."

THE Committee on Scientific Research of the American Medical Association has granted to the New York Homeopathic Medical College and Flower Hospital for the work of Dr. Israel S. Kleiner, professor of chemistry, the sum of $500 to aid in work on crystalized enzymes. The Littauer Foundation has made possible the continuation of his work on studies in diabetes, by a second gift of $1,800. Mr. Lewis Emery has made a gift of $2,150 to Dr. E. Risley Eaton, associate professor of medicine, for studies in arthritis.

PROFESSOR T. H. GOODSPEED, on sabbatical leave from the department of botany of the University of California, and at present carrying on research in the biological institute of the Kaiser Wilhelm Gesellschaft under a fellowship of the Guggenheim Foundation, spoke at the third "Dahlemer Biologischer Abend" on January 12 on "Effects of High Frequency Radiation on Species of Nicotiana."

THE George Fisher Baker non-resident lecturer in chemistry at Cornell University for the present university term is Dr. Nevil V. Sidgwick, of Oxford University. Dr. Sidgwick will conduct a course of lectures on "Molecular Structure and the Periodic Classification" and will hold weekly colloquiums for the benefit of advanced students in chemistry. He is the eleventh holder of the non-resident lectureship founded by George Fisher Baker in 1925, which in accordance with the terms of the foundation is filled in succession by men eminent in chemistry or in some related branch of science.

YALE UNIVERSITY announces the appointment of Dr. Heinrich Wieland, professor of organic chemistry at the University of Munich, and one of the editors of the *Annalen der Chemie*, as Silliman lecturer for the current year. The subject of the lectures will be "Researches on Oxidation Reaction." They will be given at 4:15 P. M., in the lecture room of the Sterling Chemistry Laboratory on March 16, 18, 20, 23, 25 and 26. As provided for by the Silliman Foundation, these lectures in amplified form will be published by the Yale University Press as a volume of the Silliman series. A correspondent writes: "The eminence of Dr. Wieland as an organic chemist and biochemist and his important researches in the field which he has chosen for the subject of the forthcoming course ensure another notable addition to the Silliman series, which already includes many important contributions by distinguished scientists in various fields."

PROFESSOR R. H. FOWLER, of Trinity College, Cambridge, will give a series of twenty-four lectures at the University of Wisconsin on "Some Recent Developments in Theoretical Physics." The topics to be covered include electron emission, the theory of ferromagnetism, the internal absorption coefficient for gamma rays and Milne's theory of the internal constitution of the stars. The lectures will begin on April 1 and will continue through April and May. Visitors are invited to attend the lectures.

PROFESSOR CHARLES GALTON DARWIN, professor of natural philosophy in the University of Edinburgh, will lecture at the Lowell Institute, Boston, during March and April.

DR. FRITZ S. BODENHEIMER, author of the comprehensive "History of Entomology before Linné,"

known for his work on the relation of climate to epidemiology, has been appointed lecturer in entomology at the University of Minnesota for the spring term. His topic for the series will be "Insect Physiology, the Regulating Mechanism of Insect Epidemiology and Biocoenotics."

DR. KEIVIN BURNS, assistant director of the Allegheny Observatory, will give a lecture and laboratory course in "Precision Spectroscopy" at the coming summer session of the University of Michigan.

DR. GEORGE K. BURGESS, director of the Bureau of Standards, gave a lecture before the Maryland Academy of Science on February 18 as one of a series on the value of scientific research in industry arranged in cooperation with the Baltimore Association of Commerce. Under the leadership of Dr. Robert B. Owens, director of the academy, it is hoped to increase the membership to 500 and to collect $50,000 to assist in making the academy, of which Dr. William H. Howell, director of the School of Hygiene and Public Health of the Johns Hopkins University, is president, "a scientific instrument to render valuable assistance to the industries of Maryland."

DR. DAVID WHITE, principal geologist of the U. S. Geological Survey, will give a course of six lectures at Yale University under the auspices of the department of geological sciences during the last week of February and first week of March on "The Geology of Coals."

DR. JOSEPH C. ARTHUR, dean of American botanists, professor emeritus of botany at Purdue University, was the guest of the Pennsylvania State College on February 18 at which time he spoke on "Disentangling the Rusts" in the series of lectures sponsored this year by the School of Agriculture.

PROFESSOR JAMES F. NORRIS, of the department of chemistry at the Massachusetts Institute of Technology, will give three lectures at Bowdoin College during the coming semester under the auspices of the department of chemistry.

DR. S. O. MAST, of the Johns Hopkins University, recently gave an address on "Amoebae" before the faculty and graduate students in the department of biology of Western Reserve University.

PROFESSOR EDWARD W. BERRY, of the Johns Hopkins University, lectured recently at the University of Illinois. His subjects were: "The Evolution of Floras," "The Evolution of Faunas," "Principles of Paleontology," "Principles of Historical Geology" and "The Geological History of the Mississippi Embayment."

RECENT lectures given before the Royal Canadian Institute, Toronto, include a lecture on "The Geysers of Yellowstone Park," by Dr. Arthur L. Day, of the Geophysical Laboratory of the Carnegie Institution, and a lecture on "Wild Flowers" by Mrs. Mary Vaux Walcott, of the Board of Indian Commissioners.

LECTURES of the Royal College of Physicians will be given this year as follows: Surgeon Captain S. F. Dudley, R.N., will deliver the Milroy Lectures on February 26 and March 3 and 5 on "Some Lessons of the Distribution of Infectious Disease in the Royal Navy"; Dr. Macdonald Critchley, the Goulstonian Lectures on March 10, 12 and 17 on "The Neurology of Old Age," and Sir William Willcox the Lumleian Lectures on March 19, 24 and 26 on "Toxic Jaundice."

BY the will of the late Albert B. Kuppenheimer the University of Chicago receives an endowment fund of about $1,000,000 for medical research. The Michael Reese Hospital receives $500,000.

YALE UNIVERSITY will eventually receive a fund of $577,732, the income of which will be used to provide scholarships for students of American ancestry, under the terms of the will of Dr. William Whitney Hawkes, who was for many years one of Connecticut's leading physicians and surgeons. Dr. Hawkes was a graduate of the college and of the medical school.

THE new Charles Franklin Kettering Laboratory of Applied Physiology at the University of Cincinnati College of Medicine, Cincinnati, has been dedicated. It is designed primarily for research work in occupational diseases. Dr. Robert A. Kehoe is director. Mr. Kettering, of Dayton, and other industrial leaders, who contributed $130,000 for erection of the laboratory, have provided an annual fund of $40,000 for its operation.

ON account of the proximity of the forthcoming Pasadena meeting of the American Association for the Advancement of Science at the end of June, the executive committee of the Southwestern Division has voted to omit the regular meeting of the division which would ordinarily occur next April. The next meeting of the division will take place in Colorado, at a place as yet unselected, in the spring of 1932.

PREPARATIONS for the twelfth annual industrial conference at the Pennsylvania State College are being made by the School of Engineering. Dean R. L. Sackett announces that arrangements are being completed to have as speakers representatives of the foremost industries in Pennsylvania. The conference will be held for three days, May 13, 14 and 15, with the general aim of bringing the college into closer cooperation with industry, thus giving to industry a better perspective of the college work.

The fourth annual conference of workers who are engaged in the study of the root-rot disease (caused by *Phymatotrichum omnivorum*) was held at College Station, Texas, on January 19 and 20. This conference, which is part of the cooperative attack on the root-rot problem by the United States Department of Agriculture and the Texas Agricultural Experiment Station, affords a yearly opportunity for the prompt presentation of results secured during the previous year at the many laboratories and field stations at which work on the problem is under way. The 46 papers presented at the present conference included results from six laboratories and field and plat studies from eight stations. A total of 34 plant pathologists, soil chemists, agronomists, botanists and horticulturists took part in the discussions. Director A. B. Conner, of the Texas Experiment Station, and Dr. Oswald Schreiner, of the United States Department of Agriculture, presided at the various sessions. A report of the results presented at this conference will appear in *Phytopathology*.

On Wednesday afternoon, December 31, those interested in hydrobiology and aquiculture met for papers and discussion in the Herrick Room of the Medical Library Building of Western Reserve University. Dr. E. A. Birge, of the University of Wisconsin, acted as chairman. The secretary, Dr. P. R. Needham, University of Rochester, writes that this was the second special meeting of this group to be held in conjunction with the American Association for the Advancement of Science, the first having been held in Des Moines last year. The great amount of interest in these subjects was evidenced by the attendance which was well over one hundred persons. There were fourteen papers given, most of which were illustrated by lantern slides. Delivery of papers occupied most of the afternoon and discussion periods were all too brief. The subjects covered were as broad as the field of hydrobiology itself and were in most cases the results of research carried on by the speakers. Seven of the papers had to do with lakes and covered such phases as light transmission, gases in solution, thermal stratification, plankton, bottom faunas and fishery problems. Three of the papers were on ecology and life histories of fishes. The only paper having to do with salt-water was one given by Professor Thurlow Nelson, of Rutgers University, on oyster larvae and their reactions to currents and salinity of waters. Most of the papers had to do with pure hydrobiology. Little was said on the more practical aspects of aquiculture or the means by which our bodies of water are to be made into producing units. The meeting was very successful from all points of view.

The Council of the American Association for the Advancement of Science at the Cleveland meeting passed on January 1, 1931, the following resolution on the revision of the copyright laws of the United States:

Whereas, There is prospect of Congressional action at this session on the long discussed Vestal General Revision Copyright Bill (H. R. 12549), which includes among its many just and progressive provisions the qualifying of the United States for entrance into the International Copyright Union, and

Whereas, It is highly desirable that the United States outlaw piracy and thus in turn obtain for its authors and composers the automatic protection which is afforded by membership in this Union; it is hereby

Resolved, That the council of the American Association for the Advancement of Science hereby expresses its hearty approval of the Vestal Bill, and it is further

Resolved, That the council recommends that, if without defeating passage, the bill be amended to preserve to the individual, whether resident or incoming, his old privilege of importing for use all legitimate foreign books without intervention, and also to provide for adherence to the 1928 Convention of the Union instead of the 1908 convention, as provided in the present bill.

DISCUSSION

ORIGIN OF PALOUSE HILLS TOPOGRAPHY

That part of the loess-covered Columbia plateau which lies in the adjoining counties of Whitman, Washington, and Latah, Idaho, possesses a curious rolling mature topography which has puzzled geographers and physiographers because it appears to belie the topographic age of the surrounding and adjacent country.

This rolling topography has been locally called "the Palouse Hills" from the time of the early white settlers. It is an area of extremely dissected loess, with a relief of more than 150 feet bearing relatively few streams, and presents an aspect so unusual that it is gradually becoming known as a new type, the Palouse Hills topography.

Guesses at its origin over a period of forty years have attributed the unusual topographic forms to normal stream erosion, to aeolian deposition, even to barchan dunes of loess. Unfortunately, the field evidence fails to support any of these hypotheses satisfactorily.

The only topographic map of the area is the Pullman, Washington, quadrangle and its large contour interval and small scale fail to show the most characteristic features of the Palouse Hills topography. It was not until 1927 that Dr. Francis A. Thomson, president of the Montana School of Mines, but at that time dean of the School of Mines at Moscow, Idaho, crossed the region by aeroplane and noticed that nearly all of the intermittent streams tributary to the main drainage lines headed in cirque-like bottle-necked amphitheaters. The studies of the authors,

inspired by his observations, showed that about 90 per cent. of the minor valleys which drain into the regular stream channels are of the cirque-like amphitheater type. These valleys are streamless throughout the year and carry water only for a week or two in the spring when the snow melts and produces a temporary sheet run-off which is concentrated in the bottoms of the valley heads.

The cirque-like amphitheaters range from a few feet to several hundred yards in diameter. In the smaller ones the bowl or amphitheater is nearly circular in ground plan, but the larger and doubtless older ones have an oval plan, opening at the lower and smaller end to debouch into another amphitheater or into a normal stream valley. In all the smaller and younger types and in the majority of older and larger examples the debouchure is constricted into a small bottle neck. Variant forms have a constricted S-shaped neck or a non-constricted neck which is no wider than the cirque-like depression at the head.

The walls of the amphitheater are always notably steep and concave in profile. The depth is, of course, controlled by the thickness of the loess mantle which in some places approaches 200 feet. In no case is the depth greater than the width, and in the smaller ones it reaches only a few feet, while in the larger ones the depths are commonly 75 feet and more.

The amphitheaters are all enlarged and elongated by headward erosion and new ones are from time to time developed in the walls of the larger forms until a clover-leaf pattern becomes characteristic where two, three or more amphitheaters, each with a bottle neck, converge on the bottle-neck opening of the original amphitheater.

Studies during 1927–28–29 have permitted the detailed examination of more than sixty characteristic amphitheaters. The main drainage lines lead to the southwest and the cirque-like depressions are found on both sides of each valley and around the heads. Compass readings taken from the bottle necks to the heads were made on 65 amphitheaters and indicate a general tendency to orientation in two directions. About an equal number of amphitheaters headed to the west and opened to the east, southeast and northeast as compared to those which headed to the south and opened to the north, northeast and northwest. A few poorly developed amphitheaters headed to the north and opened to the south and southwest.

The relation of the depressions to the normal stream drainage is not the normal dendritic pattern. The amphitheaters may lie at right angles to the main valley or may join with obtuse angles opening up stream.

That the depressions were not caused by ordinary run-off and stream erosion is admitted by everyone who has given the area any study. That the crescentic depressions do not represent the lee side of barchan dunes is proven by the lack of orientation with the prevailing wind or with any consistent orientation in any one direction.

The best theory for their origin was suggested by Dr. J Harlen Bretz, professor of geology, University of Chicago. Upon his suggestion that nivation might have been a contributing cause the evidence was restudied and the writers are at this time reporting preliminary conclusions resulting from a three years study of the phenomena.

Nivation[1] appears to be the largest single contributing factor and appears to be the factor which determines the two directional orientation, the headward erosion and the cirque-like shape of the amphitheaters. Other factors, such as soil-slip, slump, mud flow and rill erosion, contribute in a minor way to the formation of these depressions.

The precipitation of the region occurs largely as snowfall and great drifts form on the valley sides and remain for several months of the year. The soft, easily eroded loess lends itself exceptionally well to erosion by nivation and to the formation of steep concave slopes on the uphill side of the drift.

The following lines of evidence indicate that nivation is the chief cause of the pseudo-cirques or amphitheaters:

1. The largest and best developed pseudo-cirques open in easterly or northerly directions. These are the sides of the valleys on which the snow drifts achieve the greatest depths and remain the longest because they are protected more from the direct rays of the winter sun. Very few hills or valley walls show concave slopes on the sunny side.

2. The steepest head slopes of the pseudo-cirques occur in those which face in northerly or easterly directions.

3. There is more mud on the north and east slopes. As long as six weeks after the south and west slopes are dry enough for cultivation, the north and east slopes are covered by mud which may be very slowly flowing across the floor.

4. In all cases the walls inside the pseudo-cirques are the steepest and most concave.

5. The drainage divides have been shifted from normal position because of greater headward erosion in some amphitheaters than in others. The divide which lies between two parallel streams flowing southwest bears amphitheaters on the southeast side which face east, southeast, and northeast, and amphitheaters

[1] Francois E. Matthes, U. S. Geol. Survey, Twenty-first Annual Report, Pt. II, pp. 179–185, 1900.

on the northwest side which face north and northwest. As these pseudo-cirques work headward the divide becomes staggered with cols, horns, and ridges analogous to the "grooved and fretted" divide in a range where mountain glaciation has occurred.

6. The mud flows are the largest on the slopes where the largest drifts occur. These in turn are in the largest valleys.

Nivation itself loosens up the loess, results in mud flows, develops concave depressions independent of drainage lines, and leaves no indication of scour or transportation.

The transfer of material from the upper edge of the snow drift, under the mass of the snow drift, by sheet erosion is very slow and would be imperceptible except for the mud flow which develops at the toe of the drift.

Annually after the drift has entirely disappeared the shady sides of the amphitheaters retain soil moisture much longer than the other sides and slump and soil slip result. The scar resulting from the slip exposes a still steeper surface in the loess to run-off and rill erosion.

During the early spring the walls of the amphitheaters are scarred by soil slips. These extend down the slope from the point of inflection to the bottom, forming black V-shaped gashes on the surface. The slips occasionally move the surface layer to a depth of one foot, but a few inches is the common depth. Gentle spring rains form rills, which in turn follow the soil slips and thus intensify and localize the erosion.

In conclusion it can be said that the predominant process of dissection of the loess-covered plateau is by the formation and enlargement of amphitheaters. All of the valleys and depressions regardless of age present the characteristic curves of maturity with the upper part convex and the lower part concave.

A full discussion of this type of erosion and topography is in preparation. It will be accompanied by large-scale topographic maps, cross-sections, aërial and landscape photographs and statistical data, all of which amply justify the above conclusion.

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A FOSSIL CYCAD IN NEW JERSEY

THE clay deposits belonging to the Raritan formation of the Cretaceous near Woodbridge, New Jersey, which in the eighties of last century yielded so many fossil leaf impressions to Newberry, have recently furnished an unusual specimen. A member of the party of Rutgers University geologists who were removing a group of footprints of a dinosaur picked up the piece of lignite which forms the subject of this note, and submitted it to me for examination. The specimen represents the apical region of a trunk with a large number of scales standing out from this, the whole having a diameter of about 180 mm, while the diameter of the trunk proper is 85 mm. The tips of the scales have been worn away, so that the original diameter of the fossil was probably as much as 200 mm. Some detached scales measure about 50 mm long by 18 mm wide, and are 4 mm thick at the middle, which region forms a broad thickened ridge on each surface of the scale. These organs were apparently narrower and thicker in their distal region, contracting to a diamond-shaped area on the free end.

In spite of the weathered condition of the specimen it has been found possible to make out several imbedded fructifications which superficially resemble those of the cycadeoids described by Wieland and others. Although the axis of the specimen shows a poor state of preservation, certain of the scale-like organs look so favorable that they have been converted into serial sections by the celloidin method. A study of these has shown that they have precisely the same arrangement of their vascular strands as is figured by Carruthers for the leaf-bases of the English cycadeoids. Moreover, our specimen shows a well-developed covering of epidermal scales or ramenta of the same type as those figured by Carruthers and by Wieland. The minute structure of the vascular bundles of our specimen has been compared with Wieland's photographs and found to correspond. The evidence for the view that the scale-like lateral organs are leaf-bases appears convincing. A striking feature of the New Jersey specimen is the excessive development of periderm, which not only surrounds each leaf-base but penetrates it in various directions, resulting in an extensive fragmentation of the organ. An odd feature of certain leaf-bases is the presence of a fossilized fungus which appears to have been parasitic. The evidence at hand points with certainty to the conclusion that we have here a species of *Cycadeoidea*. The nearest locality from which the genus has been reported is Maryland. The discovery of a specimen in New Jersey raises some questions with respect to the sort of climate which prevailed in this region during the Cretaceous period. Taking into account the xerophytic characters exhibited by the conifers occurring in the Cretaceous beds of Staten Island, and described by Hollick and Jeffrey, we may venture the opinion that New Jersey was both warmer and drier during the Cretaceous

than it is at present, in fact the region may have presented more or less the aspect of a desert.

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PLURAL FRACTIONS

FROM time to time correspondents unburden their minds in these columns of sundry loads of worry about the low state of our written and spoken language. Constant Reader has learned to look for old friends among the words mentioned as horrible and convincing examples, and he would be surprised to find that the English courses in high school and college are not blamed for the deplorable condition. My own personal theory is distinctly different, but will not be aired now. The reason for writing is to call attention to a common mistake for which the decimal system must be blamed.

In reading common fractions such as $\frac{4}{100}$ or $\frac{893}{10000}$ gram, one naturally says "four one-hundredths (of a) gram," and similarly for the ten-thousandths. Yet in recent journals these fractions were given as "0.04 grams" and "0.0893 grams." It is not necessary to give references because the mistake is of wide occurrence, and is an argument for the practice of some journals never to use the names of units in the plural. It is easy to see why so many writers use and editors permit the wrong use of the plural. Think of the way decimals are commonly read. "Oh, point, oh, four gram—no, the last figure is four, so it must be grams."

The "oh," it may be remarked in passing, seems to indicate a great public necessity as the cause of the approaching obsolescence of "zero" in reading decimals. As for "naught" it seems to have died when we were young. Do school children still start the two table with "twice naught's naught"?

If the decimals we have given are bad, what can be said of 0.1 or 0.01 grams? Such expressions can be seen if the reader will look for them.

In tabulated data the column headings are often in the plural, though space is at a premium and all the figures in the column are less than unity. In a recent article "Potential, Volts" occurs seventeen times, though the maximum voltage is -0.825. In spite of the minus sign it would not be fair to say that the value is less than nothing, and is that much farther from being plural.

In the same number of the last journal negative powers of 10 play their frequent plural role. For instance, just because it is written 7×10^{-12}, the value 0.000 000 000 007 is ergs! One would like to say that this is a misprint, but the evidence does not in general encourage the charitable thought. On another page can be found "varied from 5–0. 3 x 10^{-4} g. calories." Seconds, grams and other units in varying negative powers of 10 are common occurrences.

Finally, in the ergs journal a writer says that so and so "occurs at every 2×10^{3} collision." He would not think of writing or saying "at every two collision," but perhaps "at every second collision." Why was he led astray by an exponent?

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WHY PATHOGENE RATHER THAN PATHOGEN?

IN printing this word, quite a good many authors in the states, including the U. S. Department of Agriculture and some universities, use the final "e"; many others do not and many abroad do not. As I recollect, the innovation started with the editorial board of *Phytopathology*. Doubtless the U. S. Department of Agriculture followed the usage of that journal, as did a few universities. I have had my doubts as to the need or even desirability of such usage and have always written the word "pathogen."

I was supported in my view by the opinions I received from several distinguished men of letters, among them Stuart P. Sherman, who said: "Why certainly not, no more use for the 'e' than in oxygen and hydrogen." I wonder if those insistent upon the final "e" use it in naming these two gases. I think the matter is also very well stated by my colleague Professor E. E. Schneider, of the faculty here, who says:

> To me pathogene seems simply absurd. Of course, English is so outrageously inconsistent in spelling that almost no rules can be laid down, but in a case like this, where we have such long-established analogous words as oxygen and hydrogen, I can't see any sense in using a different form. Anyhow, all these forms are from a root *gen* (as in Greek, γεννάω; Latin, gens, genus, generare) and *not* from some established nominal or adjectival form having a proper termination of its own, so why not let it go at that? It is true that *gene* has common use, but that is also an arbitrary modern formation, and so does not, to my understanding, constitute a valid precedent for other formations.
>
> My usual rule in the choice between two spellings is this: To choose the simpler one always when there is any authority for it at all, provided the simpler spelling is easily understood, does not conflict with any fairly well-established rule or practice and, finally, does not lead to any possible ambiguity.

Now a little matter of history. At about the time "pathogene" was being insisted upon there appeared

in *Phytopathology* quite a eulogy regarding some one who had hit upon the wonderfully useful term inoculum. I forget now who made this wonderful innovation. But I do know that for several years prior to that time I had been using the word inoculum and that many others also had done so.

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SCIENTIFIC BOOKS

Living Africa. A Geologist's Wanderings through the Rift Valleys. By BAILEY WILLIS. New York: Whittlesey House, McGraw-Hill Book Company, Inc., 1930, pp. xv, 320, illustrated.

THE unique geologic feature of eastern Africa is its rifted plateaus with their rift valleys and their rift lakes. On no other continent are the ancient geologic formations so markedly split asunder, so torn apart, and so deeply cracked, and as a result it is one of the greatest regions of the earth for upwellings of molten rock from the heated interior. The rift valleys begin with the Dead Sea trough of Palestine, continue on through the deep Red Sea, and thence somewhat disconnectedly through eastern Africa to Lake Nyasa. In other words, the rift structures continue for 4,000 miles south of the Jordan.

The problem of the cause of this unique fault system has long fascinated geologists. Is it the consequence of tension, due to the deep subsidence of the Indian Ocean, which in late Mesozoic time began to pull down and break apart eastern Africa north to the Jordan? There is no agreement as to the answer, and it is therefore well that an American geologist who is fully conversant with the grand faulting of the Great Basin and California should take a good look at the rifting of eastern Africa and Palestine. This Willis has done under the fostering care of the Carnegie Institution of Washington, examining the rift valleys for a length in excess of 1,500 miles.

Central Africa is not only the land of high plateaus and long narrow lakes, but the place where the Congo and Nile rivers now have their origin; the country of active and recently extinct volcanoes, some with snowy tops; of much earthquake movement; of great mammalian game; of the deadly tsetse fly; and of nightly ice formation within the tropics. Amidst these interesting but frequently difficult conditions, Willis traveled more than 6,000 miles in six months, climbing volcanoes and walking twenty miles a day on safari, and all this in his seventy-second year!

"Living Africa" (living, because Africa is still growing geologically) is Willis' narrative of what he saw of the natural history, physical and organic, with accounts of the natives and the white people who helped him on his way, sprinkled with descriptions of the geological phenomena and what he thought about them from day to day. Later we are to get his technical report of the geologic structures and his final explanation of their causation. The present volume opens with "The Question" (pp. 1–15): How does the crust of the earth move?, continues with twenty-one chapters of narration (19–286), and closes with "The Answer" (287–310). It is a wonderfully interesting book, written in a clear, spirited, optimistic and humorous style, and why not, since the author was accompanied everywhere by his "Solomon"?

The Scottish geologist, J. W. Gregory, also visited the rift valleys of East Africa, first in 1892–1893 and again in 1919, and two years later published his book, "The Rift Valleys and Geology of East Africa." Willis agrees with Gregory that the Eastern or Great rift "is a crack, an effect of tension in the earth's crust," but adds, "We see the cause of tension from different points of view." The Great Rift valley of Africa is 650 miles long and from 20 to 30 miles wide; the superficial rocks are lavas and volcanoes piled upon a Precambrian crystalline basement. The Western rift is far more complex geologically than the eastern one and has a length of 850 miles. In Ruwenzori the old basement, here in the form of a wedge, has been squeezed upward through horizontal compression to 16,794 feet above sea-level, and other similarly shaped blocks have either risen or been depressed by the same forces. "The mountains said it, the rivers roared it, and the lakes acquiesced" (p. 96). It is the physiography of the plateaus, the curiously changed stream pattern, the nature of the crystalline basement on which rest the strings of volcanoes with their lava flows that guide Willis in his interpretation of the rifting and its causation.

"The recent uplift of the African plateaus and the development of the rift valleys constitute the group of facts that we have to throw against the background of the ancient history of Africa as a relatively modern expression of the forces that have created and shaped the continent since the beginning" (p. 291). These movements, in Willis' opinion, began in the late Mesozoic, and the first major upwarping, with differential movement of as much as 3,000 feet, may have taken place in the early Cenozoic. "The great western rift shows evidences of horizontal compression throughout its entire length" (p. 295). The Lake Victoria "disk" is 450 miles across, a high plateau with a saucer-like lake depression, and with margins that are upraised

mountain blocks and erupted molten masses. These marginal features are evidences of pressure exerted around the margin, pressure seemingly due to expansion of the disk.

The primary causation of all crustal movement, Willis thinks, is heat. The earth is "a heat engine, but I do not know how it works." Heat is the "tricky sprite that is forever playing with the established order of things," while the "great, primal, all-pervading force is the attraction of gravity" (p. 10). It appears, then, that the heat engine is at work when the deep-seated molten magmas rise into the thick crust or lithosphere and elevate large blocks into plateaus, while the subsequent crystallizing forces of the cooling intrusions plus gravity bring about horizontal pressure, rifting, and differential block movements.

Willis does not believe that there ever was a Gondwana continent, which foundered into oceanic depths in late Mesozoic time, making the Indian Ocean. He may be correct, but the reviewer prefers to continue his belief in theoretic Gondwana, and all the more so after reading "Radioactivity and Earth Movements" by Arthur Holmes (Trans. Geol. Soc. Glasgow, vol. 18, pt. 3, 1928–1929, pp. 559–606). Here also is to be found another hypothesis explaining rift valleys (see pp. 595–598).

The reviewer heartily recommends the reading of "Living Africa" to all geologists and graduate students in geology. The narrative illustrates how a master geologist works in the field, what he thinks about the phenomena seen, and how his conclusions change from time to time as observations increase. Students of structural geology are especially advised to study the first and last chapters in the book, so that they may learn more of the rise of certain geological theories, of the earth's primary internal forces, and of the "heat engine" of Willis. All in all, "Living Africa" is an interesting book, which stimulates thought along the line of multiple hypotheses.

CHARLES SCHUCHERT

SCIENTIFIC APPARATUS AND LABORATORY METHODS

A METHOD OF STAINING THE OOCYSTS OF COCCIDIA

ALL who have worked with the coccidia are familiar with the difficulties involved in studying the internal structure of the spores inside the mature oocysts. The refractive character of these bodies is often so pronounced that it is often next to impossible to observe for a certainty the number, size and shape of the sporozoites and the nature and size of the sporocystic residual body, if one is present. A study of the internal structures of the sporozite (nucleus, refractile bodies, granules) is often out of the question—a statement attested to by the frequency with which recent authors have omitted these structures from their figures. We have stumbled onto a technique which has proved extremely useful to us in some of our researches upon the coccidia.

The fecal material from the culture is strained through a double layer of cheesecloth. The filtrate is centrifuged in ordinary pointed centrifuge tubes, the supernatant liquid drawn off, more water added, and the mixture thoroughly shaken. This process is repeated three times in order to remove as much débris as possible. After the last centrifuging, concentrated salt solution is added to the sediment in the tubes, and the mixture is again shaken and centrifuged. The oocysts come to be present in the surface film and are transferred onto a glass slide by means of a platinum loop. The drop is covered with a No. 1 cover-glass.

A few drops of glacial acetic acid are placed on one end of the slide and barely in contact with one edge of the coverslip. The salt solution is withdrawn by absorbing it with a blotter at the other edge of the cover, and the acid follows the solution through the narrow space beneath the cover. Most of the oocysts are held in place by contact with the glass above and below when the proper care is taken in applying the cover. When it is certain that all the salt solution has been replaced by the acid, the slide is warmed gently over a light bulb for five or ten minutes. The acid is not permitted to evaporate, however.

At the end of this time the glacial acetic acid beneath the cover is replaced by a fresh Janus green solution made up in the proportion of one part of the dye to a thousand parts of distilled water. The dye solution is drawn beneath the cover by means of a blotter as explained above. The dye remains for ten minutes, and at the end of this time the oocysts are thoroughly washed by drawing distilled water beneath the cover-glass. The water is replaced by a concentrated solution of eosin in water, and this dye is left for five minutes.

Then follows a washing with distilled water as before. The entire process of staining may be followed under the low power of the microscope. If all the excess water at the margins of the cover-glass is removed by blotting, the edges may be sealed with amber vaseline or glycerine jelly. The stained oocysts should be studied under the oil immersion lens.

The oocyst jelly stains red, and sometimes the

sporocyst wall assumes a reddish tint. We can not agree between ourselves whether or not the sporozoites are stained a very light blue. At any rate the structures within the sporocyst are rendered visible. We suspect that the improved optical properties are the result of reducing the glare by staining the material about the sporocysts.

The foregoing procedure may be variously modified. The technique may be adapted to oocysts in a test tube instead of under a cover-glass. Also, we have found that if the fresh, non-sporulated cysts are used instead of those in the sporulated condition, development will occur beneath the cover-glass if heat is not applied while the preparation is flooded with acetic acid.

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THE LIGATION OF EARTHWORMS TO REMOVE THE ANTERIOR OR POSTERIOR END

During experiments conducted on the regeneration of blood vessels in earthworms, it was desired to remove the anterior thirteen somites. To effect this removal of tissue the following method was found to be superior to the usual method of cutting with a scalpel.

This method consists of tying the worm tightly enough to cause the end to slough off. In a six- to eight-inch piece of number 00 silk thread, a single knot is tied and drawn to a quarter-inch loop through which the worm is caused to crawl. The number of somites can be counted as the worm crawls through the loop and at the desired point the knot is drawn tight enough to constrict the worm to the smallest diameter without cutting the body wall. A little practice will determine how much pressure can be applied to the silk to obtain the desired result. This knot should be tied quickly and drawn against the finger with the ends of the silk on each side of the finger to prevent the worm from twisting into the thread. A second and third knot is then tied and the surplus silk clipped off.

The anterior end remains attached to the posterior for from two to four days; if it remains attached longer than this it is probable that the first knot was not tied tightly enough and a second tying is necessary.

This method is far more successful than that of cutting for several reasons. When the silk is tied around the worm a large quantity of mucus is secreted protecting the region. When the anterior end sloughs off the surface left exposed is very small, averaging about one millimeter in diameter. Around this end at the time of separation there is already a protecting fringe of proliferated epithelium. Extrusion of the digestive tract is very rare, allowing more rapid recovery. When worms are cut with the scalpel the contractions of the body wall often force the digestive tract out, and at best leaves a large surface exposed for bacterial infection, causing high mortality.

A point of great importance, in the work on blood vessels, is the retention of all the blood in the vessels. When the worms are severed by the scalpel much blood is lost. By tying, all the blood is kept in the vessels, leaving the worm in better condition

In summing up the advantages of this method it may be said that it is far superior to cutting, allowing the animal to readjust itself more gradually to the loss of tissue. While the shock of tying the worm so tightly may be as great as the shock of cutting, certainly the post-operative effects are not so great. Regeneration starts more quickly and proceeds more rapidly. Worms severed in this manner showed signs of feeding activities in about one to one and one half months.

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SPECIAL ARTICLES

ON A RELEASE-PHENOMENON IN ELECTRICAL STIMULATION OF THE "MOTOR" CEREBRAL CORTEX

The starting-point for this investigation was the question as to how the excitability of a motor point of the cerebral cortex and eventually the reactions obtained by its stimulation would be influenced, if changes occurred at all, when the surrounding parts of the cortex were put out of function. To avoid as far as possible shock-producing effects on the cortex, we decided to produce a functional block of the cortex round the motor point under investigation by local anesthesia with novocaine.

The general course of these experiments was as follows: general anesthesia of the animal by intraperitoneal injection of Dial (0.4–0.6 cc Dial Ciba per kg bodyweight), which leaves, as Fulton, Liddell and Rioch recently have shown, the cortex rather well excitable for electrical stimulation. After 1 to 2 hours, or even longer, when an even stage of narcosis is reached, the threshold of a point of the so-called motor cortex was determined for faradic bipolar or

unipolar stimulation during periods of from 5 or 10 seconds, at intervals of 1.5 to 2 minutes. After showing that several of these liminal stimulations yielded constant responses, 1 per cent. novocaine solution colored by toluidine blue was applied round the point, and the stimulation of the motor focus was continued at regular intervals of from 1.5 to 2 minutes. The area around the motor point, surrounded by the novocainized cortex, usually had a diameter of about 8 mm.

When the general condition of the animal remains constant, one finds in the cat, dog and monkey (*Macacus rhesus*) that after 8 to 15 minutes, usually at about 13 minutes, the excitability of the motor point is *augmented, i.e.,* the threshold for the point in question is diminished, or that when the strength of stimulus is kept unchanged throughout the whole experiment, the responses are distinctly stronger and even wider spread; a point which before the novocainization, at 13 cm coil-distance, gave rise to a slight flexion of the fingers of the contralateral hand, may now yield, at the same coil-distance, not only a much stronger flexion of the fingers, but also flexion of the wrist and often flexion of the elbow and retraction of the shoulder. In the cat and the dog we occasionally observed spread of the response to the hind limb of the same side, or, if the primary stimulation took place on the hind leg, a spread of response towards the front leg. Occasionally, also, a reversal together with augmentation of the response could be observed, *e.g.,* the primary liminal flexion changed after the novocainization into a much stronger extension of the same joint and of other joints of the same limb. Very often a marked clonic, partial epileptoid after-discharge entered into the picture. We have obtained in the monkey this augmentation of responses from the face, arm and leg areas of the cortex. This augmentation, which only sets in after a long latent period of from 8 to 15 minutes, subsides after 20 to 45 minutes. Renewed application of novocaine often gives rise once more to the appearance of the phenomenon.

Cortical facilitation is a well-known phenomenon since Exner discovered it in 1882; and especially so since through the investigations of Graham Brown and Sherrington it is known that cortical motor points do not yield fixed reactions, but are more or less "instable," because upon repeated stimulation of a motor point or after stimulation of another cortical antagonistic point, the response may be augmented or may change in pattern, *e.g.,* from extension into flexion (primary and secondary facilitation). These phenomena occur, at least so far as is now known, only when the two liminal stimuli succeed each other within a few seconds, intervals of one minute being sufficient to do away with any ordinary facilitation known at present. In introducing intervals of from 1.5 to 2 minutes we actually did not observe any facilitation, before the local anesthesia with novocaine.

The long latency of 8 to 15 minutes also points in the direction, that in this curious phenomenon of augmentation of response we have not to do with a primary phase of hyperexcitability of the local anesthesia. So far as we know, such a phase, if present at all, in local novocaine-anesthesia is much less marked than in local narcosis by cocaine and stovaine, and even here this primary phase of hyperexcitability through which the nerve goes (for which most of the investigations on changes in excitability during local anesthesia are carried out) occurs within the first minute or minutes after the application and soon passes away. Furthermore, novocainization of a motor point itself gives rise to a marked depression or even a temporary extinction of its excitability. We may safely assume, therefore, in our experiments, that this explanation does not account for the augmentation of response.

The explanation of our phenomenon is difficult to give in the present state of our knowledge of cortical functions. Perhaps the most probable hypothesis is to look upon it as a phenomenon of "release" of function in the sense of Hughlings Jackson and Head, the excitability of a small area of the cortex cerebri becoming (temporarily) augmented when it is "released" from the influence of the surrounding cortical areas.

We have not succeeded in obtaining this phenomenon after circumcision of a cortical point; the circumcision gives rise, as might be expected, to a long lasting depression or loss of excitability of the motor point. Apparently we succeeded in establishing our phenomenon with novocaine because this drug blocks functionally, but without producing cortical shock.

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THE ETIOLOGY OF SWINE INFLUENZA

SWINE influenza ("hog flu") was first recognized as a clinical entity in 1918 and since then has reappeared in epizootic form each autumn and winter in the swine raising states of the middle west. It bears a striking resemblance to influenza in man. Experimentally, the disease can be readily transmitted by contact and also by the introduction of tracheal exudate from infected animals into the nasal passages of normal swine. Eight strains of the disease have been established among our experimental swine during the three years it has been under investigation in this laboratory.

In these experimental infections as well as in diseased animals studied in the field an organism, first isolated by the late Dr. Paul A. Lewis, with whom this investigation was started, has been found constantly

present. This organism is very similar if not identical to non-indol-producing strains of Pfeiffer's bacillus. Oftentimes the organism has been obtained in pure culture from the involved lung and bronchial exudate. It has not been found in the respiratory tract of normal swine. Freshly isolated cultures of the organism, when administered intranasally, may produce a disease which might be confused with the natural infection in swine but which, unlike the natural disease, is not contagious. Cultures on artificial media for two months or longer are non-pathogenic.

Suspensions of tracheal exudate and lung from infected animals passed through Berkefeld N filters, when introduced into the nasal passages of normal swine, cause a variable disease complex, apparently dependent upon the strain of infectious material under study. One strain, obtained in 1928, produced a clinical picture and lesions which closely resembled those following the intranasal injection of unfiltered infectious material. With other strains the disease produced by the filtrate has been very mild and transient and sometimes difficult of certain recognition. The contrast between the mild disease caused by the filtrate and the typical disease induced by unfiltered infectious material has been particularly striking with two strains of the disease obtained in 1930. In all instances bacteriological examination of the lung and tracheal exudate of filtrate infected swine has failed to reveal the influenza-like organism and sometimes these sites have been found bacteriologically sterile. The mild disease induced by the filtrate is contagious.

If a small amount of a culture of the influenza-like bacillus, carried on artificial media for over two years and long since non-pathogenic for swine, is added to a Berkefeld N filtrate and this mixture injected intranasally into normal swine, a typical swine influenza results and this disease is transmissible by contact to other swine. In such experiments control animals inoculated with culture alone remain perfectly normal, animals receiving filtrate alone develop a mild, transient, scarcely recognizable disease, while animals receiving a mixture of the two develop typical swine influenza.

The experimental data obtained in the investigation and briefly outlined in this note indicate that the primary inciting agent in swine influenza is filterable. However, since the influenza-like bacillus is always found in field and experimental cases and is capable experimentally of converting the mild disease caused by the filtrate into clinically and pathologically typical swine influenza, it seems probable that both the filterable agent and the bacillus are etiologically essential to the production of the disease and that, in this rôle, they act synergistically.

It is conceivable that these results may be suggestive in the study of influenza and certain other respiratory infections in man and animals.

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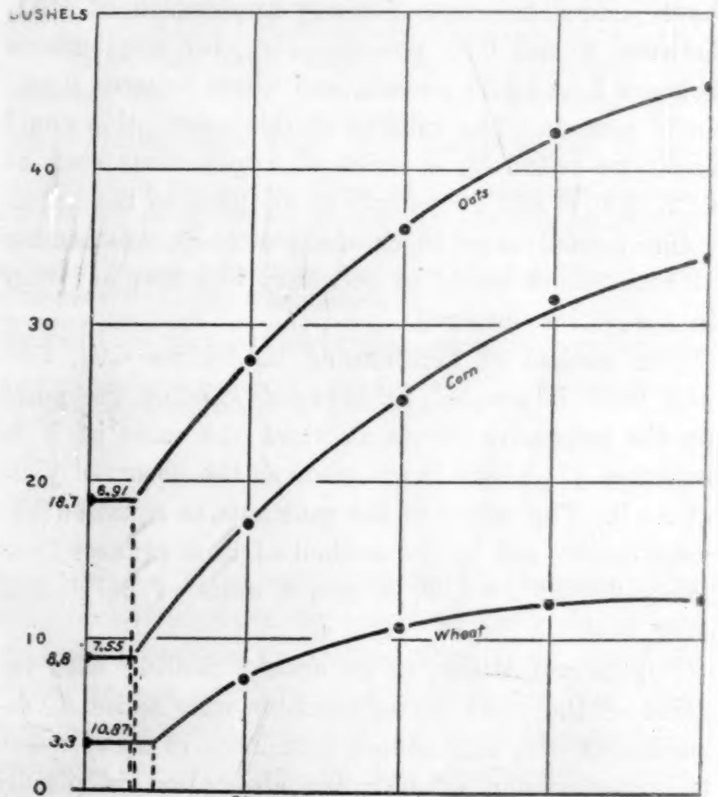
MEASURING ABSORBED PHOSPHATES AND NITROGEN

WHEN phosphate or nitrate fertilizers are applied in certain cases small amounts of the plant food element appear to be absorbed by the soil and held in a condition unavailable to the growing crop. The usual increase in yield with increasing applications appears not to begin until the quantity applied exceeds the amount that can thus be absorbed. Whether potash is similarly absorbed is not yet known.

The purpose of this communication is to point out what seems to be a method of measuring the amount of a plant food element absorbed in the manner above described. The accompanying drawing shows the re-



lation between amount of phosphoric acid applied and corresponding yields of oats, corn and wheat at the Snowshoe Branch Station of the Pennsylvania Experiment Station, as reported in Pennsylvania Bulletin No. 166.

The dots along the curves show actual yields. The curves are calculated from the yields for 24, 48, 72 and 96 pounds of P_2O_5 for each crop by means of the equation

$$Y = M - AR^x \qquad (1)$$

in which Y is the yield when x units (of 24 pounds each) of P_2O_5 are applied per acre, M is the maximum toward which the yield increases as x increases indefinitely, A is the difference between M and the yield for $x=0$, and R is the ratio of the decreasing geometric series of which the terms are the increments of Y corresponding to successive unit increases in x.

From applications of 24 to 96 pounds of P_2O_5, the agreement between actual and expected yields is excellent. But in each case the yield for $x=0$ lies considerably above the curve. The facts are explained if we assume that, of the phosphates applied, 6.91 pounds per acre are absorbed by the soil and held in a condition unavailable to oats, the corresponding figure for corn being 7.55 pounds and for wheat 10.87 pounds.

In previous work I have found that corn can obtain considerably more phosphate from a given soil than can wheat.

If the above assumptions are correct, oats should have yielded the same for any application of P_2O_5 between 0 and 6.91 pounds; corn for applications between 0 and 7.55 pounds, and wheat between 0 and 10.87 pounds. The validity of this assumption could easily be tested by a series of applications such as 0, 2, 4, 6, 8 and 10 pounds in addition to the application actually used in these experiments. A number of replications would be necessary to insure accuracy in the yields obtained.

The method of determining the values 6.91, 7.55 and 10.87 is simple. It is merely to find the point on the respective curves at which the value of Y in equation (1) above is the same as the observed yield at $x=0$. The values of the constants in equation (1) were determined by the method of least squares from the yields at $x=1$, 2, 3, and 4 units of 24 pounds P_2O_5 each.

Niklas and Miller, in an article[1] dealing with the form of the yield curve, assemble nine series of experiments with nitrogenous fertilizers, in all of which the phenomenon of nitrogen absorption is plainly evident. I have taken the trouble to recalculate the constants in the yield equation for each of these nine series, first with the yield at $x=0$ included, second, with this yield omitted. In each case the curve calculated without the yield at $x=0$ fits the observed yields better than that calculated with Y_0 included. This indicates that some nitrogen is actually absorbed in each series of experiments. Evidence of nitrogen absorption also appears in some field experiments in this country, particularly on delta soils in Mississippi.

In view of this situation it is obvious that in accurate experimental work with fertilizers the check plots should not be left unfertilized; they should receive an application of fertilizer at least as large as the quantity the soil is capable of absorbing and holding in a condition unavailable to the growing crop.

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[1] H. Niklas and M. Miller, "Beiträge zur Mathematischen Formulierung des Ertraggesetzes," *Zeitsch. f. Pfl.-ernahr., Düng. u. Bodenkunde*, Teil A, 8 Band, Heft 5., S. 289–297.

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